COMBINED VOICE AND INSTRUMENT DATA SYSTEM

BACKGROUND

Voice-Over-IP is the name given to a system wherein voice, such as from voice telephone calls, is transported over a network, which could be for example the Internet, using standard Internet Protocol (IP) packets. Such systems provide the capability of carrying both data and the voice information using a single infrastructure. Development efforts directed to such systems, as well as protocols for use with them, have intensified over the past few years. In these systems, data-oriented switches can be used to switch data, including packetized voice.

Several advantages are inherent in such systems. In particular, the multiplexing of data and voice signals can result in a better utilization of bandwidth than is typically possible in voice only systems. The system provider thereby benefits by the more efficient utilization of his resources with an associated higher profit, while the customer stands to enjoy the benefits of the lower cost associated with this more efficient utilization of resources.

Current systems can utilize an audio-capable computer and/or a telephone connected to a public switched telephone network (PTSN) on either or both ends of the voice-over-IP system. In other words, the endpoints of a two party system could include (1) an audio-capable computer at the calling end of the system and an audio-capable computer at the called end of the system, (2) a telephone connected to a public switched telephone network at the calling end of the system and a telephone connected to a public switched telephone network at the called end of the system, (3) a telephone connected to a public switched telephone network at the calling end of the system and an audio-capable computer at the called end of the system, or (4) an audio-capable computer at the calling end of the system and a telephone connected to a public switched telephone network at the called end of the system.

Voice-Over-IP devices communicate with each other using signaling and voice-transporting protocols. Various standardization entities have specified standards for both signaling and voice-transporting protocols in order to insure the interoperability between products from different vendors.

SUMMARY OF THE INVENTION

In representative embodiments an instrument system is described which includes an electronic instrument and a network interface module. The network interface module and the electronic instrument interchange electronic instrument data via a first connector, the network interface module and a voice module interchange voice data via a second connector, and the network interface module and a network interchange combined data (i.e., instrument data and voice data) via a third connector. The voice data has been converted to Internet protocol (IP) packets to allow it to be combined with the instrument data. The network interface module provides the means for combining instrument data and voice data into the outgoing data stream, and for separating the incoming data stream into its instrument data and voice data components. Additionally, the network interface module may also provide functionality to convert analog voice signals to digital voice data and/or to convert digital voice data into analog voice signals.

Other aspects and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings provide visual representations which will be used to more fully describe the invention and can be used by those skilled in the art to better understand it and its inherent advantages. In these drawings, like reference numerals identify corresponding elements.

Figure 1 is a drawing of an instrument system as described in various representative embodiments consistent with the teachings of the invention.

Figure 2 is a drawing of an instrument system connected to a remote diagnostic system as described in various representative embodiments consistent with the teachings of the invention.

Figure 3 is a drawing of another instrument system as described in various representative embodiments consistent with the teachings of the invention.

Figure 4 is a drawing of still another instrument system as described in various representative embodiments consistent with the teachings of the invention.

Figure 5 is a drawing of yet another instrument system as described in various representative embodiments consistent with the teachings of the invention.

DETAILED DESCRIPTION

Shown in the drawings for purposes of illustration is a Voice-Over-IP instrument system. Previously, close contact between remotely located diagnostic personnel and instrument systems has required separate data and voice paths. Systems disclosed herein provide this close contact between remotely located diagnostic personnel and electronic test instrument locations using a single network connection.

In the following detailed description and in the several figures of the drawings, like elements are identified with like reference numerals.

Figure 1 is a drawing of an instrument system **100** as described in various representative embodiments consistent with the teachings of the invention. In Figure 1, the instrument system **100** includes an electronic instrument **105** connected to a network interface module **110** via a first connector **115**, also referred to herein as a data connector **115**. The network interface module **110** and the electronic instrument **105** interchange instrument data via the first connector **115**. The network interface module **110** and a voice module **120** interchange voice data via a second connector **125**, also referred to herein as a voice connector **125**, wherein the voice data is in the form of an electronic signal. Voice module **120** or network interface module **110** provides a data conversion function wherein the analog voice data is converted to digital information and compressed into IP packets, and also provides the reverse functionality wherein the incoming voice data IP packets are converted back into analog signals. The network interface module **110** combines instrument and voice data into the outgoing data stream, and separates the incoming data stream into its voice and instrument data components. The network interface module **110** and a network **130** interchange combined voice and instrument data via a third connector **135**, also referred to herein as a network connector **135**.

The electronic instrument **105**, in various implementations, may comprise a display **106** for displaying data values and various control knobs **107** for controlling various setup and operational functions of the electronic instrument **105**.

The voice module **120** comprises a transducer **140** which in the representative

embodiment of Figure 1 is a speaker **140**. The voice module **120** further comprises an on/off switch **145**. While not required, the voice module **120** is shown in Figure 1 as physically attached to the electronic instrument **105**. The network interface module **110** is also shown physically attached to the electronic instrument **105** and to the voice module **120**. In an alternative embodiment, the voice module **120** may comprise two transducers **140**, one acting as a speaker and a second acting as a microphone. In yet other embodiments, the on/off switch **145** is omitted.

A call button **147** could be provided wherein an operator or engineer at the instrument location could press that button **147** which could be located on the instrument chassis, thereby automatically connecting to a support location for support help for the instrument **105**. The system **100** is easily integrated with remote on-line support for the instrument **105** which enables remote diagnostics of the instrument **105**.

In typical applications, the network **130** is a Local Area Network (LAN) **130** or a Wide Area Network (WAN) **130** such as the Internet **130**.

Figure 2 is a drawing of the instrument system **100** connected to a remote diagnostic system **200** as described in various representative embodiments consistent with the teachings of the invention. In the representative embodiment of Figure 2, instrument data obtained by the electronic instrument **105** is transferred to the network interface module **110** at the first connector **115**. An operator at the same location as the electronic instrument **105** could be in communication with another individual located remote from the operator's location by, for example, speaking into and/or listening to the speaker **140** in voice module **120**.

In a representative situation, the voice module **120** is a telephone **120** with a speaker **140** (i.e., a speaker phone **120**) built into the instrument chassis. The operator speaks into the speaker **140** which is a transducer **140** that transforms his voice into an electronic signal that may be amplified by the voice module **120**. This electronic signal is referred to herein as voice data. Additionally, the voice data may be converted into digital form and compressed into IP packets by voice module **120**. The voice data is transferred to the network interface module **110** at the second connector **125**. If the voice data is not already in the form of IP packets, network interface module **110** converts the

voice data into IP packets, as mentioned above. The network interface module **110** then combines the instrument data from the electronic instrument **105** with voice data in IP format from the voice module **120** to form a combined data stream which is typically in a packetized format. The combined data is then transferred to the network **130** via third connector **135**.

First connector **115** could be any electronic connector appropriate to the particular application. The first connector **115** could be, for example, a wire, a feed-thru, a plug and receptacle, a high-frequency connector, a fiber optics interface, or the like. Second connector **125** could also be any electronic connector appropriate to the particular application. The second connector **125** could be, for example, a wire, a feed-thru, a plug and receptacle, a standard telephone plug and/or receptacle, or the like. Third connector **135** could be any electronic connector appropriate to the particular application. The third connector **135** could be, for example, a wire, a feed-thru, a plug and receptacle, a high-frequency connector, an Ethernet connector, a fiber optics interface, or the like. The third connector **135** could also provide a wireless connection to another network-enabled device connected to the network **130**.

The combined data transferred to the network **130** via third connector **135** by the network interface module **110** is transported by the network **130** to a remote system **200** which in the representative embodiment of Figure 2 is shown as a computer system **200**. The remote system **200** could comprise additional network connector **235** which may or may not be of the same type as found on the network interface module **110** which is attached to the electronic instrument **105**. Combined instrument and voice data is transported from the network **130** to additional network interface module **210** via additional network connector **235**. The network interface module **210** of the remote system **200** separates the combined voice and instrument data received from the network **130** into voice data and instrument data.

The instrument data is transferred from the additional network interface module **210** via additional data connector **215** to a remote data analysis instrument **250** which is shown in Figure 2 as a computer central processing unit (CPU) **255** with a computer monitor **260**. However, the data analysis instrument **250** could also comprise any other

electronic system appropriate to the particular application.

The voice data may be decoded and converted to an analog signal by the additional network interface module **210**. The voice data is transferred from the additional network interface module **210** via additional voice connector **225** to additional voice module **220** located at the remote system **200**. If the voice data has not yet been decoded and converted into an analog signal, additional voice module **220** will provide this function. The additional voice module **220** located at the remote system **200** comprises a transducer **240**, wherein the transducer **240** transforms the electronic voice data received from additional network interface module **210** into sounds replicating the human voice. The additional voice module **220** further comprises an on/off switch **245**. While not required, the additional voice module **220** is shown in Figure 2 as physically attached to the remote data analysis instrument **250**. The additional network interface module **210** is also shown physically attached to the remote data analysis electronic instrument **250** and to the additional voice module **220**. In the representative embodiment of Figure 2, the transducer **240** is shown as speaker **240**. Thereby, the operator located at the electronic instrument **105** can easily convey a spoken message to an individual located at the remote system **200**. At the same time and using the same network connections, data from the electronic instrument **105** is transferred to the remote data analysis instrument **250**. In an alternative embodiment, the additional voice module **220** may comprise two transducers **240**, one acting as a speaker and a second acting as a microphone. In still other embodiments, the on/off switch **245** is omitted.

The additional data connector **215** could be any electronic connector appropriate to the particular application. The additional data connector **215** could be, for example, a wire, a feed-thru, a plug and receptacle, a high-frequency connector, a fiber optics interface, or the like. Additional voice connector **225** could also be any electronic connector appropriate to the particular application. The additional voice connector **225** could be, for example, a wire, a feed-thru, a plug and receptacle, a standard telephone plug and/or receptacle, or the like. Additional network connector **235** could be any electronic connector appropriate to the particular application. The additional network connector **235** could be, for example, a wire, a feed-thru, a plug and receptacle, a high-

frequency connector, an Ethernet connector, a fiber optics interface, or the like. The additional network connector **235** could also provide a wireless connection to another network-enabled device connected to the network **130**.

In a manner similar to the above and in a representative situation, the additional voice module **220** is a telephone **220** with a speaker **240** (i.e., a speaker phone **220**) built into the chassis of the remote data analysis instrument **250**. Personnel at, for example, a diagnostic center can speak into the speaker **240**, which is a transducer **240** that transforms that individual's voice into an electronic signal that may be amplified by the additional voice module **220**. Additionally, the voice data may be converted into digital form and compressed into IP packets by the additional voice module **220**. The voice data is transferred to the additional network interface module **210** at the additional voice connector **225**. If the voice data is not already in the form of IP packets, additional network interface module **210** converts the voice data into IP packets as mentioned above. The additional network interface module **210** then combines the instrument data from the remote data analysis instrument **250** with voice data in IP format from the additional voice module **220** to form a combined data stream which is typically in a packetized format. The combined data is then transferred to the network **130** via additional network connector **235**.

The combined data transferred to the network **130** by the additional network interface module **210** via additional network connector **235** is transported by the network **130** to the instrument system **100**. The combined data is transferred from the network **130** to the network interface module **110** via the third connector **135**. The network interface module **110** of the instrument system **100** separates the combined data received from the network **130** into voice data and instrument data.

The instrument data is transferred via first connector **115** to the electronic instrument **105**. The voice data may be decoded and converted to an analog signal by the network interface module **110**. The voice data is transferred via second connector **125** to voice module **120** located at the instrument system **100**. If the voice data has not yet been decoded and converted into an analog signal, voice module **120** will provide this function. As previously stated, the voice module **120** located at the instrument system

100 comprises at lease one transducer **140**, wherein the transducer **140** transforms the electronic voice data received from network interface module **110** into sounds replicating the human voice. In the representative embodiment of Figure 2, the transducer **140** is shown as speaker **140**. Thereby, the operator located at the electronic instrument **105** can easily receive a spoken message from an individual located at the remote system **200**. At the same time and using the same network connections, data from the remote data analysis instrument **250** can be transferred to the electronic instrument **105**.

Figure 3 is a drawing of another instrument system **100** as described in various representative embodiments consistent with the teachings of the invention. In Figure 3, the voice module **120** is shown as separated into various components comprising voice-module electronics **305** and a handset **310**, wherein the handset **310** is typically connected to the voice-module electronics **305** via a handset cord **315** which could be, for example, plugged into a handset jack **320** attached to the voice-module electronics **305**. The handset **310** may also have a wireless connection, i.e., radio frequency (RF) or infrared (IR) to the voice-module electronics **305**. A hook **312** attached to the instrument chassis may be used for storing the handset **310**. The hook **312** may also perform the function of the on/off switch **145** as is common practice in the telephone industry.

Figure 4 is a drawing of still another instrument system **100** as described in various representative embodiments consistent with the teachings of the invention. In Figure 4, the voice module **120** is shown as separated into various components comprising voice-module electronics **305** and a headset **410**, wherein the headset **410** is typically connected to the voice-module electronics **305** via a headset cord **415** which could be, for example, plugged into the handset jack **320** attached to the voice-module electronics **305**. The headset **410** may also have a wireless connection, i.e., radio frequency (RF) or infrared (IR) to the voice-module electronics **305**. The headset **410** would typically comprise one or two earphones **470** and a microphone **475**.

Figure 5 is a drawing of yet another instrument system **100** as described in various representative embodiments consistent with the teachings of the invention. In Figure 5, the voice module **120** is shown as physically separated from the electronic instrument **105** and the network interface module **110**. The voice module **120** is further shown as a

conventional telephone **120**. Various components of the telephone are shown, as for example, handset **310** connected to the telephone base **505**. The telephone base **505** would house the voice-module electronics **305** indicated in Figure Figures 3 and 4. Handset **310** connects to the voice-module electronics **305** via handset cord **315** and the voice-module electronics **305** connects to the network interface module **110** via telephone cord **515** which could be, for example, plugged into a telephone jack **520** attached to the voice-module electronics **305**.

As is the case in many products involving data-processing, certain elements of the above described embodiments may be implemented as a combination of hardware and software components. Moreover, certain elements of the functionality required for using these embodiments may be embodied in computer-readable media to be used in programming an information-processing apparatus (e.g., a personal computer comprising the elements shown in Figure 2) to perform as described with respect to the above.

The term "computer readable media" is broadly defined herein to include any kind of computer memory such as, but not limited to, floppy disks, conventional hard disks, DVD's, CD-ROM's, Flash ROM's, nonvolatile ROM, Flash RAM, other nonvolatile RAM, and RAM.

The display of the computer monitor **260** shown in Figure 2 may be monochrome or color, and a pointing device (not shown) such as pen, mouse, track point or a touch screen that is suitable for cursor manipulation may be used.

The computer central processing unit **255** can be capable of running any commercially available operating system such as DOS, any of a variety of Windows operating systems including, for example, Windows 2000 or XP, Unix (including Linux), real-time operating systems such as VxWorks, or any other suitable operating system. The operating system can include support of a spreadsheet, database, or other specialized data collection software.

The total real cost of instrument ownership should include the costs of instrument downtime due to instrument malfunction, instrumentation updating, and other reasons, as well as cost of service contracts and calls. Such costs can be reduced by the effective use of remote support of the electronic instruments. Remote support often includes the

physical presence of an operator and/or engineer. The engineer may be employed by the company owning the instrument, by the manufacturer of the instrument, or by a third party. Often these individuals need to speak with an individual in a remotely located instrument customer support facility.

In various instrument environments, as for example, the production floor of a manufacturing facility, telephones or even telephone outlets may not be conveniently located with respect to the instrument. In such situations, cell phones would be a possible choice. However, it is possible that due to the nature of the manufacturer's facility, cell phones may not be allowed or due to the location of the cell phone provider's antennas such use is not possible. Further, long distance calls can become expensive for the long durations that may be required to solve a given instrument problem. Representative embodiments of the integrated voice-over-IP instrument system disclosed herein provide a convenient, cost effective means for voice and data communication between an individual located at an electronic instrument and a remotely located monitoring/troubleshooting facility. All that is needed at the instrument location is a connection to a network, as for example an Ethernet network. Tie-ins to such local area networks which are in turn connected to a Wide-Area Network (such as the internet) are becoming more and more common.

A call button **147** via additional network connector **235** (see Figure 1) could be provided wherein the operator or engineer at the instrument location could press that button which could be conveniently located on the instrument, thereby automatically connecting to a support location in case support help is needed for the instrument. This interface could also be provided through a "virtual button", i.e., an item on the instrument display that the user could select, such as with a mouse-click or other user action. The system is easily integrated with remote on-line support for the instrument which enables remote diagnostics of the instrument.

Voice-over-IP requires only a small increase in bandwidth over the standard data transmissions required for diagnostics of a problem.

While the present invention has been described in detail in relation to preferred embodiments thereof, the described embodiments have been presented by way of

example and not by way of limitation. It will be understood by those skilled in the art that various changes may be made in the form and details of the described embodiments resulting in equivalent embodiments that remain within the scope of the appended claims.